PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 54.

May 26, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Thomas Chapman, Esq., was balloted for, and duly elected into the Society.

Richard Quain, Esq., was also balloted for, but was not elected into the Society.

A paper was in part read, entitled, "On the Transparency of the Atmosphere, and the Law of Extinction of the Solar Rays in passing through it." By James D. Forbes, Esq., F.R.S., Sec. R.S. Edinb., Professor of Natural Philosophy in the University of Edinburgh.

June 2, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The reading of a paper, entitled, "On the Transparency of the Atmosphere, and the Law of Extinction of the Solar Rays in passing through it." By James D. Forbes, Esq., F.R.S., &c., was resumed and concluded.

This paper is divided into seven sections. In the first, the qualities of heat and light are considered in as far as they modify the comparability and absolute nature of our measures of the influence of the solar rays. All instruments, whether called *Thermometers*, *Photometers*, or *Actinometers*, measure but the peculiar effect to which their construction renders them sensible, but are incompetent to give absolute measures of either heat or light.

The second section treats of the history of the problem of the law and measure of extinction of the solar rays in passing through the atmosphere of the earth in clear weather. The labours of Bouguer, Lambert, De Saussure, Leslie, Herschel, Kämtz and Pouillet are successively passed under review, and their instrumental methods considered.

In the third section, a mathematical problem of considerable difficulty and interest is investigated; principally after the manner of

Laplace. It consists in the determination of the length of the path and the mass of air which a ray of light must traverse in passing through the earth's atmosphere at every different angle of obliquity. The author determines the numerical value of these quantities for all angles of incidence from 0° to 90°.

The fourth section contains an account of the observations made by the author in conjunction with Professor Kämtz in 1832. These were conducted in 1832 at the top and bottom of the Faulhorn, a mountain of the canton of Berne in Switzerland. The lower station was Brientz, and the intercepted stratum of air had 6800 English feet of thickness, corresponding in its weight to about one-fourth of the entire atmosphere. Frequent observations were simultaneously made with the actinometer and other meteorological instruments at both stations, and the loss of solar heat in passing through the intervening mass of air was thus directly determined.

In the fifth section, the observations made from sunrise to sunset, on one peculiarly favourable day (the 25th September, 1832), are carefully analysed; and from the absorption at various obliquities, the law of extinction in the atmosphere, within the limits of observation, is attempted to be deduced.

The sixth and seventh sections include the results of similar, but less perfect observations in 1832 and in 1841.

From the facts and reasonings of this paper, the author deduces, on the whole, the following conclusions:—

1. The absorption of the solar rays by the strata of air to which we have immediate access is considerable in amount for even moderate thicknesses.

2. The diurnal curve of solar intensity has, even in its most normal state, several inflections; and its character depends materially on the elevation of the point of observation.

3. The approximations to the value of extra-atmospheric radiation, on the hypothesis of a geometrical diminution of intensity, are inaccurate.

4. The tendency to absorption through increasing thicknesses of air is a diminishing one; and in point of fact, the absorption almost certainly reaches a limit beyond which no further loss will take place by an increased thickness of similar atmospheric ingredients. The residual heat, tested by the absorption into a blue liquor, may amount to between half and a third of that which reaches the surface of the earth after a vertical transmission through a clear atmosphere.

5. The law of absorption in a clear and dry atmosphere, equivalent to between one and four thicknesses of the mass of air traversed vertically, may be represented, within those limits, by an intensity diminishing in a geometrical progression, having for its limit the value already mentioned. Hence the amount of vertical transmission has always, hitherto, been greatly overrated; or the value of extra-atmospheric solar radiation greatly underrated.

6. The value of extra-atmospheric solar radiation, on the hypothesis of the above law being generally true, is 73° of the actino-

meter marked B 2. The limiting value of the solar radiation, after passing through an *indefinite* atmospheric thickness, is 15° 2′.

7. The absorption, in passing through a vertical atmosphere of 760 millimeters of mercury, is such as to reduce the incident heat from 1 to 0·534.

8. The physical cause of this law of absorption appears to be the non-homogeneity of the incident rays of heat, which, parting with their more absorbable elements, become continually more persistent in their character; as Lambert and others have shown to take place, when plates of glass are interposed between a source of heat and a thermometer.

9. Treating the observations on Bouguer's hypothesis of a uniform rate of extinction to the intensity of the incident rays, the author obtains for the value of the vertically transmitted shares of solar heat in the entire atmosphere,—

By the *relative* intensities at Brientz and the Faulhorn...	0·6842
By the observations at the Faulhorn alone,—	
First method	0·6848
Second method	0·7544
By the observations at Brientz alone,—	
First method	0·7602
Second method	0·7827

The President informed the Meeting that the Council had voted the following Address to Her Majesty, the Queen.

"*To the Queen's Most Excellent Majesty.*

"The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to approach Your Majesty's throne with the expression of our deep sorrow that any subject of Your Majesty should dare to lift his arm against Your Majesty's sacred person. We offer up to Divine Providence the grateful homage of our hearts, that He has been graciously pleased to guard a life so valuable to all the inhabitants of these realms; and we pray most fervently that the same Almighty Protection may long preserve Your Majesty in the possession of health and every other blessing to your family and your people."

The President informed the Meeting that the Council had adopted the following Address to His Royal Highness Prince Albert of Saxe Coburg and Gotha:—

"*To His Royal Highness Prince Albert of Saxe Coburg and Gotha, K.G., F.R.S., &c.*

"The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"May it please Your Royal Highness,

"We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg to be permitted, on the present occasion, to offer to Your Royal Highness our congratulation on the providential escape of Her Majesty and Your Royal Highness from the murderous attack of an assassin.

"That the same Almighty Arm may continue to preserve Her Majesty and Your Royal Highness from every danger, and from every evil, is our most sincere and earnest prayer."

June 9, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

A paper was read, entitled, "On the Specific Inductive Capacities of certain Electric Substances." By William Snow Harris, Esq., F.R.S.

The author, pursuing the experimental inquiry suggested by the theory of Mr. Faraday relative to the differences in specific inductive capacity exhibited by different dialectric substances, instituted a series of experiments for determining with precision their comparative powers of insulation, and of sustaining by induction charges of electricity. The substances to be examined were cast into the form of circular plates and furnished on both their surfaces with circular coatings of tinfoil of a diameter equal to one-half that of the plate, and the electric intensities were measured by electrometers of the same construction as those which he used in his former experiments, and which he has described in his papers already published in the Philosophical Transactions for 1839. The results are stated in tables; from the last of which it appears that the inductive capacities of the dialectric bodies tried, that of air being expressed by unity, are proportional to the following numbers:—

Substances.	Relative capacities.
Air	1
Rosin	1·77
Pitch	1·8
Bees' wax	1·86
Glass	1·9
Brimstone	1·93
Shell-lac	1·95

The author, in conclusion, offers some observations on the expe-

rimental processes employed in his investigation; and points out several circumstances which require to be attended to in order to ensure success.

June 16, 1842.

SIR JOHN W. LUBBOCK, Bart., V.P. and Treas., in the Chair.

The following papers were read, viz.—

1. "On the Action of the Rays of the Solar Spectrum on Vegetable Colours." By Sir John Frederick William Herschel, Bart., K.H., F.R.S.

The author, having prosecuted the inquiry, the first steps of which he communicated in a paper read to the Royal Society in February 1840, relating to the effects of the solar spectrum on the colouring matter of the *Viola tricolor*, and on the resin of guaiacum, relates, in the present paper, the results of an extensive series of similar experiments, both on those substances, and also on a great number of vegetable colours, derived from the petals of flowers, and the leaves of various plants. In the case of the destruction of colour of the preparations of guaiacum, which takes place by the action of heat, as well as by the more refrangible rays of light, he ascertained that although the non-luminous thermic rays produce an effect, in as far as they communicate heat, they are yet incapable of effecting that peculiar chemical change which other rays, much less copiously endowed with heating power, produce in the same experiment. He also found that the discoloration produced by the less refrangible rays is much accelerated by the application of artificial terrestrial heat, whether communicated by conduction or by radiation; while, on the other hand, it is in no degree promoted by the purely thermic rays beyond the spectrum, acting under precisely similar circumstances, and in an equal degree of condensation. The author proceeds to describe, in great detail, the photographic effects produced on papers coloured by various vegetable juices, and afterwards washed with solutions of particular salts; and gives a minute account of the manipulations he employed for the purpose of imparting to paper the greatest degree of sensitiveness to the action of solar light. This action he found to be exceedingly various, both as regards its total intensity and the distribution of the active rays over the spectrum. He observed, however, that the following peculiarities obtain almost universally in the species of action exerted.

First, the action is *positive*; that is to say, light destroys colour, either totally, or leaving a residual tint, on which it has no further, or a very much slower action; thus effecting a sort of chromatic analysis, in which two distinct elements of colour are separated, by destroying the one and leaving the other outstanding. The older the paper, or the tincture with which it is stained, the greater is the amount of this residual tint.

Secondly, the action of the spectrum is confined, or nearly so, to the region of it occupied by the luminous rays, as contra-distinguished both from the so-called chemical rays beyond the violet, (which act with chief energy on argentine compounds, but are here for the most part ineffective,) on the one hand, and on the other, from the thermic rays beyond the red, which appear to be totally ineffective. Indeed, the author has not hitherto met with any instance of the extension of this description of photographic action on vegetable colours beyond, or even quite up to the extreme red.

Besides these, the author also observed that the rays which are effective in destroying a given tint, are, in a great many cases, those whose union produces a colour complementary to the tint destroyed, or at least one belonging to that class of colours to which such complementary tint may be referred. Yellows tending towards orange, for example, are destroyed with more energy by the blue rays; blues by the red, orange and yellow rays; purples and pinks by yellow and green rays. These phenomena may be regarded as separating the luminous rays by a broadly defined line of chemical distinction from the non-luminous; but whether they act *as such*, or in virtue of some peculiar chemical quality of the heat which accompanies them *as heat*, is a point which the author considers his experiments on guaiacum as leaving rather equivocal. In the latter alternative, he observes, chemists must henceforward recognise, in heat from different sources, differences not simply of intensity, but also of quality; that is to say, not merely as regards the strictly chemical changes it is capable of effecting in ingredients subjected to its influence.

One of the most remarkable results of this inquiry has been the discovery of a process, circumstantially described by the author, by which paper washed over with a solution of ammonio-citrate of iron, dried, and then washed over with a solution of ferro-sesquicyanuret of potassium, is rendered capable of receiving with great rapidity a photographic image, which, from being originally faint and sometimes scarcely perceptible, is immediately called forth on being washed over with a neutral solution of gold. The picture does not at once acquire its full intensity, but darkens with great rapidity up to a certain point, when the resulting photograph attains a sharpness and perfection of detail which nothing can surpass. To this process the author applies the name of *Chrysotype*, to recall to mind its analogy with the Calotype process of Mr. Talbot, to which in its general effect it affords so close a parallel.

2. "Experimental Researches on the Elliptic Polarization of Light." By the Rev. Baden Powell, M.A., F.R.S., Savilian Professor of Geometry in the University of Oxford.

This paper contains an experimental investigation of the phenomena of elliptic polarization resulting from the reflexion of polarized light from metallic surfaces, and the theory on which they are explicable; the analytical results being given in a tabular form, and applied to the cases of the experiments themselves.

3. "On the Influence of the Moon on the Atmospheric Pressure, as deduced from the Observations of the Barometer made at the Magnetic Observatory at St. Helena." By Lieutenant J. H. Lefroy, R.A., late Director of that Observatory. Communicated by Lieut.-Col. Sabine, R.A., F.R.S.

In order to determine the dependence of the barometric pressure on lunar influence, the author arranges all the two-hourly observations in each lunar month with relation to the time of the moon's passing the meridian; entering in one column the observation of each day nearest to the meridian passage, whether before or after; and entering in separate columns those corresponding to two hours, four hours, six hours, &c., before and also after that observation. The monthly means at every two hours from the meridian passage are then taken; and again, the means at the same intervals, for each three months from September 1840 to December 1841. From the results thus obtained the author states that it appears that the moon's passage over both the inferior and superior meridian produces a slight increase of pressure; a maximum in the curve occurring at both (that of the latter being slightly the greater), while the minima correspond to the moon's rising or setting.

It appears also, that the rise of the tides will not account for the whole amount of the increase of pressure, even admitting that it has a tendency to produce an effect of that nature. The times of maxima do not correspond; and there appears to be no atmospheric establishment. The pressure is greater about the period of new moon than at full moon; and greater in the third and fourth than in the first and second quarters; a result which agrees with that given by Mr. Howard for the climate of London. The observations of both years agree in making the pressure greater under the Perigee than under the Apogee. Mr. Howard had found that the mean pressure in Great Britain, which is in the opposite hemisphere from St. Helena, is greater under the Apogee than under the Perigee.

4. "Notices of the Aurora Australis from the 1st to the 31st of March 1841, made on board H.M.S. Erebus; extracted from the log-book." By Captain James Clark Ross, R.N., F.R.S.

5. "An Appendix to a paper on the Nervous Ganglia of the Uterus, with a further Account of the Nervous Structures of that Organ." By Robert Lee, M.D., F.R.S.

After premising a short history of the opinions of Galen, Dr. William Hunter, Mr. John Hunter, Professor Tiedemann, Professor Lobstein, and Professor Osiander, relative to the existence, course, and enlargement of the nerves of the uterus, the author adverts to his own researches on this subject, which commenced with his discovery, in April 1838, of the trunk of a large nerve accompanying the uterine vein, and of the great nervous plexus with which it was continuous. Of this discovery he gave an account to the Royal Society in a paper read on the 12th of December of the same year. In a subsequent paper, he described some large nervous ganglia

situated at the neck of the uterus; and in the present appendix he describes other nervous structures of still greater size which presented themselves to him, on a still more complete dissection which he made of a gravid uterus at the full period of gestation. It appears from the results of these dissections that the human uterus possesses a great and extensive system of nerves, which enlarge during pregnancy, along with the coats, blood-vessels, and absorbents of that organ, and which after parturition resume their original condition. It is chiefly through the influence conveyed by these nerves that the uterus is rendered capable of performing its various functions, and by which sympathies are established between it and other parts of the system.

6. "Magnetic-term Observations of the Declination, Inclination and Total Intensity, made at the Magnetic Observatory at Prague, for February, March, and April 1842." By C. Kreil, Director of the Prague Observatory. Communicated by S. Hunter Christie, Esq., M.A., Sec. R.S.

7. "Magnetic and Meteorological Observations for February 1842, taken at the Magnetic Observatory at Madras." Presented by the Honourable Court of Directors of the East India Company. Communicated by the Council of the Royal Society. (*Packet No.* 73.)

8. "Magnetic and Meteorological Observations from May 1841 to March 1842, made at the Observatory established by the Rajah of Travancore, at Trevandrum, transmitted to the Royal Society by command of His Highness the Rajah." By John Caldecott, Esq., F.R.S., Director of the Observatory at Trevandrum.

The Society then adjourned over the long vacation, to meet again on the 17th of November next.